



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

ROLAND BRUNNER ET AL.

Serial No.: 09/425,694

Filed: October 22, 1999

For: PROCESS FOR THE WET CHEMICAL TREATMENT OF
SEMICONDUCTOR WAFERS

Attorney Docket No.: WSAG 0148 PUS

Group Art Unit: 1765

Examiner: M. Song

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
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Sir:

This is an Appeal Brief from the final rejection of claims 1-9 and 11-15 of the
Office Action mailed on September 17, 2005 for the above-identified patent application.

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I. REAL PARTY IN INTEREST

The real party in interest is Siltronic AG ("Assignee"), a corporation of
Germany, and having its principal offices at Hanns-Seidel-Platz 4, 81737 Munich, Germany,
as set forth in the assignment recorded in the U.S. Patent and Trademark Office on October
27, 1999, at Reel 010343/Frame 0840.

CERTIFICATE OF MAILING UNDER 37 C.F.R. § 1.8

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James W. Proscia
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II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to the Appellant, the Appellant's legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-9 and 11-15 are pending in this application. Claims 1-9 and 11-15 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

A response after final rejection was filed on December 20, 2004 without any amendments.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to a process for the wet chemical treatment of semiconductor wafers, in which the semiconductor wafers are treated with treatment liquids, in particular a process for the cleaning of silicon semiconductor wafers. (Specification p. 1, ll. 16-19). In an embodiment of the invention, a process for the wet chemical treatment of semiconductor wafers is provided. The process of this embodiment includes a step in which the semiconductor wafers are treated with an aqueous HF solution containing HF and optionally HCl and an optional surfactant. (Specification p. 2, l. 1, p. 3, ll. 12-15). The semiconductor wafers are next treated in a bath with an aqueous O₃ solution containing O₃ and optionally HF. (Specification p. 2, ll. 1-2, p. 3, ll. 17-20). Finally, the semiconductor wafers are treated in a bath with an aqueous HCl solution containing HCl and optionally O₃. (Specification p. 2, l. 2, p. 4, ll. 1-2). Collectively, these treatment steps may form a treatment sequence B₂ which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths. (Specification p. 2, ll. 19-22).

In another embodiment of the invention, a process for the wet chemical treatment of semiconductor wafers that optionally uses megasonic waves is provided. The process of this embodiment includes a step in which the semiconductor wafers are treated with an aqueous HF solution containing HF and optionally HCl and an optional surfactant. (Specification p. 2, l. 1, p. 3, ll. 12-15). The semiconductor wafers are next treated in a bath with an aqueous O₃ solution containing O₃ and optionally HF. (Specification p. 2, ll. 1-2, p. 3, ll. 17-20). Finally, the semiconductor wafers are treated in a bath with an aqueous HCl solution containing HCl and optionally O₃ with optional exposure to megasonic waves. (Specification p. 2, l. 2, p. 4, ll. 1-2). Collectively, these treatment steps form a treatment sequence B₂ which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths. (Specification p. 2, ll. 19-22).

In another embodiment of the invention, a process for the wet chemical treatment of semiconductor wafers is provided. The process of this embodiment includes a step in which the semiconductor wafers are treated with an aqueous HF solution containing HF and optionally HCl and an optional surfactant. (Specification p. 2, l. 1, p. 3, ll. 12-15). The semiconductor wafers are next treated in a bath with an aqueous O₃ solution containing O₃ and optionally HF. (Specification p. 2, ll. 1-2, p. 3, ll. 17-20). Finally, the semiconductor wafers are treated in a bath with an aqueous HCl solution containing HCl and optionally O₃. (Specification p. 2, l. 2, p. 4, ll. 1-2). Finally, the treatment liquids are recirculated by taking a part from each bath, filtering and returning the part to the corresponding treatment bath. (Specification p. 2, ll. 7-12). Collectively, these treatment steps may form a treatment sequence B₂ which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths. (Specification p. 2, ll. 19-22).

In another embodiment of the invention, a process for the wet chemical treatment of semiconductor wafers is provided. The process of this embodiment includes a step in which the semiconductor wafers are treated with an aqueous HF solution containing HF

and optionally HC1 and an optional surfactant. (Specification p. 2, l. 1, p. 3, ll. 12-15). The semiconductor wafers are next treated in a bath with an aqueous O₃ solution containing O₃ and optionally HF. (Specification p. 2, ll. 1-2, p. 3, ll. 17-20). Finally, the semiconductor wafers are treated in a bath with an aqueous HC1 solution containing HC1 and optionally O₃ with optional exposure to megasonic waves. (Specification p. 2, l. 2, p. 4, ll. 1-2). Finally, the treatment liquids are recirculated by taking a part from each bath, filtering and returning the part to the corresponding treatment bath. (Specification p. 2, ll. 7-12). Collectively, these treatment steps may form a treatment sequence B₂ which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths. (Specification p. 2, ll. 19-22).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-9 and 11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Pirooz et al.* in view of *Verhaverbeke et al.*

Claims 12-15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Pirooz et al.* in view of *Verhaverbeke* and further in view of *Berman* or *Davison*. All of the previous amendments have been entered.

VII. ARGUMENT

A. Claims 1-9 and 11 Are Patentable Under 35 U.S.C. § 103(a) Over Pirooz et al. in View of Verhaverbeke et al.

Claims 1-9 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Pirooz et al.* (EP 0701275) in view of *Verhaverbeke et al.* (U.S. Patent No. 6,132,522).

Applicants respectfully traverse the rejection for the reasons set forth below. Applicants assert that the Examiner has misinterpreted the teachings of the cited prior art. *Pirooz* teaches a chemical treatment process in which two active (i.e., positive steps for metal removal are used) **without** a final step in which semiconductor wafers are treated “in a bath with an aqueous HCl solution containing HCl and optionally O₃” as required by independent claims 1 and 11. This is in contrast to the present invention in which three steps are used. *Pirooz et al.* discloses as its first step, the use of an aqueous HF treatment solution. (*Pirooz et al.*, col. 2, l. 48 - col. 3, l. 7). Next, a first rinsing step is disclosed (*Pirooz et al.*, col. 3, ll.8-13). This rinsing step is then followed by a step in which aqueous ozone treatment is deployed. *Pirooz et al.*, col. 3, ll. 25-35. Next, a second deionized water rinsing step is used if the aqueous ozone treatment included hydrochloric or nitric acid. (*Pirooz et al.*, col. 3, ll 35-40). The significance of this last rinsing step and the Examiner’s misguided attempt to equate this step with the semiconductor wafer treatment “in a bath with an aqueous HCl solution containing HCl and optionally O₃” are discussed below.

The Examiner concedes that *Pirooz et al.* is deficit in that this reference lacks at least one element of independent claims 1 and 11:

Pirooz et al **does not** teach treating the semiconductor wafers in a bath with an aqueous HCl solution only containing HCl and optionally O₃.

Office Action dated September 17, 2005 (emphasis added)

The Examiner attempts to equate this step with the second rinsing step of *Pirooz et al.* described above. The Examiner relies on *Verhaverbeke et al.* to assert that an aqueous HCl rinsing may be substituted for the deionized water rinse of *Pirooz et al.*:

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify *Pirooz et al* DI water

rinsing step with Verhaverbeke et al's rinsing fluid of an aqueous solution of HCl in a bath to prevent metal deposition ('522 col 5, In 5-15).

Office Action dated September 17, 2005

However, Pirooz et al. makes it clear that substitution of a deionized water rinse with an aqueous HCl rinse is incompatible:

If the ozonated bath is acid-free, the treated wafers may be immediately dried. **If the ozonated bath contains hydrochloric or nitric acid**, however, the treated wafers **should be rinsed** for a period of at least about 0.1 minutes and typically about 2 to about 10 minutes in **deionized water** having a resistivity of about 3 to about 18 mega-Ohms, preferably greater than about 17 mega-ohms.

Pirooz et al., col. 3, ll. 35-41 (emphasis added)

Pirooz et al. teaches away from the substitution of a deionized water rinse with an aqueous HCl rinse by making it clear that for the implementation of its treatment process, the presence of acids such as hydrochloric acid makes necessary the rinsing with deionized water. Therefore, the Examiner's assertion that a solution containing HCl can be used as a rinse is inconsistent since Pirooz seeks to remove the residue of such acid containing solutions with deionized water.

Accordingly, independent claims 1 and 11 along with dependent claims 2-9 are patentable over *Pirooz et al* and *Verhaverbeke et al.* whether considered individually or in combination under 35 U.S.C. 103(a).

Notwithstanding the arguments set forth above, claims 1-9 and 11 are patentable for not teaching the treatment sequence of the present invention. The Examiner concedes that *Pirooz et al.* does not teach the treatment sequence of the invention:

Pirooz et al also does not teach these treatment steps form a treatment sequence, which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths.

Office Action dated September 17, 2005 (emphasis added)

Again, the Examiner uses *Verhaverbeke et al.* to patch the deficiency of Pirooz et al.:

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pirooz et al with Verhaverbeke's method of sequential chemical processing without rinsing to increase output and savings (' 522 col 4, In 15-25).

Office Action dated September 17, 2005 (emphasis added)

Applicants concede that *Verhaverbeke et al.* teaches sequential chemical processing without rinsing to increase output and savings. However, this sequential chemical processing is only limited to the processes disclosed and **not to all** chemical processes. The process disclosed in *Verhaverbeke et al.* includes a reactant selected from:

The reactive chemical process fluids suitable for practicing the invention include, without limitation, aqueous solutions of hydrochloric acid and buffers comprising the same, ammonium hydroxide and buffers comprising the same, hydrogen peroxide, sulfuric acid and buffers comprising the same, **mixtures of sulfuric acid and ozone**, hydrofluoric acid and buffers comprising the same, chromic acid and buffers comprising the same, phosphoric acid and buffers comprising the same, acetic acid and buffers comprising the same, nitric acid and buffers comprising the same, ammonium fluoride buffered hydrofluoric acid, and combinations thereof. The particular process fluids

used, the equipment used, the exposure time, and the experimental conditions (i.e., temperature, concentration, and flow of the process fluid) will vary depending on the particular purpose of the particular wet processing methodology.

Verhaverbeke et al., col. 6, ll. 36-51

Although *Verhaverbeke et al.* discloses a treatment bath that may have “mixtures of sulfuric acid and ozone”, it does not disclose utilization of the “high purity ozonated water” used in *Pirooz et al.* (see, *Pirooz et al.*, col. 3, ll. 14-34). Moreover, the *Pirooz et al.* only discloses the ozonated bath as potentially having hydrochloric or nitric acid and not sulfuric acid. Since *Verhaverbeke et al.* only discloses mixtures of sulfuric acid and ozone, *Verhaverbeke et al.* does not make obvious the elimination of intermediate rinsing when the ozonated bath does not contain sulfuric acid as in *Pirooz et al.* Accordingly, independent claims 1 and 11 along with dependent claims 2-9 are patentable over *Pirooz et al.* and *Verhaverbeke et al.* whether considered individually or in combination under 35 U.S.C. 103(a) since *Verhaverbeke et al.* does not teach elimination of rinsing with deionized water when an ozone treatment step includes ozone but not sulfuric acid.

Notwithstanding the arguments set forth above, it is respectfully submitted that any attempt to combine the teachings of the *Pirooz* primary reference and the *Verhaverbeke* secondary reference would destroy the teachings of the *Pirooz* primary reference. *Pirooz* discloses a process that comprises the steps of contacting the surface of the silicon wafer with an aqueous solution containing hydrofluoric acid to remove metals from the wafer surface and contacting the hydrofluoric acid treated wafers with ozonated water to grow a hydrophilic oxide layer on the surface of the silicon wafer. (*Pirooz*, col. 1, ll. 55-59, col. 2, ll. 1-2). *Pirooz* further discloses that the rinsed wafers are contacted with high purity ozonated water, i.e., deionized water containing ozone and having a concentration of no more than about 0.01 parts per billion (weight/volume) of each of iron, chromium, titanium and other metals which will degrade minority carrier lifetime, to produce a wafer having a hydrophilic oxide surface.

(*Pirooz*, col. 3, ll. 14-30). The resulting silicon oxide layer preferably has a thickness of about 0.6 to about 1.5 nanometers and a concentration of no more than 1×10^9 , more preferably no more than about 1×10^8 atoms/cm² of each of iron, chromium, titanium and other metals which degrade minority carrier lifetime. Silicon oxide layers of this thickness and purity may be produced by immersing the wafers in a bath containing about 0.1 parts per million (ppm) to 50 ppm of ozone, preferably about 10 to about 15 ppm ozone, at a temperature of about 0°C to about 60°C, preferably room temperature, for a period of at least about 0.1 minutes, preferably about 2 to about 10 minutes. Accordingly, any further treatment of the hydrophilic oxide layer on the surface of the silicon wafer of *Pirooz* as taught by *Verhaverbeke* would destroy the properties of the surface, which surface is required by *Pirooz*. Such a radical reconstruction of the prior art references that will destroy the hydrophilic oxide layer surface as mandated by *Pirooz* is impermissible under 35 U.S.C. § 103. For at least this reason, the Examiner is unable to establish a *prima facie* case of obviousness under 35 U.S.C. § 103.

Accordingly, for the reasons set forth above, independent claims 1 and 11 along with dependent claims 2-9 are patentable over *Pirooz et al.* in view of *Verhaverbeke et al.* under 35 U.S.C. 103(a).

**B. Claims 12-15 Are Patentable Under 35 U.S.C. § 103(a)
Over *Pirooz et al.* in View of *Verhaverbeke et al.* Further
in View of *Berman* or *Davison et al.***

Claims 12-15 under 35 U.S.C. § 103(a) as being unpatentable over *Pirooz* (EP 0701275) in view of *Verhaverbeke* (U.S. Patent No. 6,132,522) as applied to claims 1-9 and 11, and further in view of *Berman* (U.S. Patent No. 5,014,737) , or *Davison et al.* (U.S. Patent No. 5,593,538).

The Applicants have set forth above reasons for the inapplicability of *Pirooz et al.* and *Verhaverbeke et al.* as applied to the present invention. Applicants arguments therein apply with equal force to claims 12-15. Accordingly, for at least this reason claims 12-15 are patentable under 35 U.S.C. § 103(a).

Notwithstanding the analysis set forth above, claims 12-15 are also patentable because the combination of *Pirooz et al.* with either Berman or Davison *et al.* is incompatible. Each of claims 12-15 include a step in which the treatment liquids of said baths are circulated by taking a part from each of said baths, filtering and returning the part to the corresponding treatment bath. The Examiner admits that the combination of *Pirooz et al.* and *Verhaverbeke et al.* are lacking with regard to this latter step:

The combination of Pirooz et al and Verhaverbeke et al teach all of the limitations of claims 12-15; except the circulating of treatment liquids of the baths by taking a part from each of the baths, filtering and returning the part to the corresponding treatment bath.

Office Action dated September 17, 2004

The Examiner utilizes Berman and Davison et al. to graft onto *Pirooz* this missing element. *Berman* discloses a recirculating chemical bath arrangement which is designed to overcome the deficiencies with regard to the two basic forms of quartz tank recirculating systems. (Berman, col. 2, ll. 50-68). This arrangement includes a quartz process tank having a trough extending about the top portion of the outer walls of the tank. The system also includes a pump/filter circuit which pumps the chemical solution into the bottom of the process tank, the liquid flowing over the tank walls into the trough. The process tank is provided with heater units secured to outer surface thereof. However, rather than connecting the pump/filter input directly to the trough, there is a second, smaller chamber secured to the end of the process tank and disposed to receive liquid flow from the trough as well as from the

process tank. The second chamber includes a fitting at the bottom thereof to supply liquid to the pump/filter circuit.

The combination of the process tank of *Pirooz et al.* with *Berman* will produce massive contamination of the treatment baths, leading to the high increase in LPD's for C1 and C2, as shown in the Table on page 5 of the Specification. For example, according to the invention, the LPD's are 7, or 30, depending upon the size of the LPD. For *Pirooz* in view of *Berman*, the corresponding number of LPD's would be 13 for C1 and would be 50 for C2, if B of the invention were 7. Again, for *Pirooz* in view of *Berman*, the corresponding number of LPD's would be 50 for C1 and would be 140 for C2, if B were 30. Thus, one skilled in the art would not combine the teachings of *Berman* with either *Pirooz* alone, or *Pirooz* in combination with *Verhaverbeke*. To do so would produce the extremely undesirable results discussed above, in which the greatly increased number of LPD's produced is completely undesirable.

Davison discloses a method for etching a substrate (*Davison*, col. 1, ll. 54-67, col. 2, ll. 1-5). More particularly, *Davison* provides a wet etching process for an oxide layer on a semiconductor material. In a wet etching process in accordance with *Davison*, polycrystalline silicon is etched when it is exposed to an etchant. The etching of the polycrystalline silicon may cause open polycrystalline silicon lines in some areas as well as reliability problems by creating very thin polycrystalline silicon lines. An objective of *Davison* is to provide an etching process that does not etch a conductive structure such as, for example, a polycrystalline silicon structure, on a semiconductor wafer. Through an extensive investigation, it has been discovered that the etching of the polycrystalline silicon structure is caused by oxygen dissolved in the etchant. Therefore, *Davison* provides a method for protecting the conductive structure on a substrate during a wet etching process by purging away oxygen dissolved in the etchant.

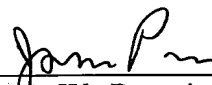
The process and apparatus of *Pirooz* in view of *Davison* again will produce massive contamination of the treatment baths leading to the huge increase in LPD's for C1 and C2, as shown in the Table on page 5 of the Specification. For example, according to the invention, the LPD's are 7, or 30, depending upon the size of the LPD. For *Pirooz* in view of *Davison*, the corresponding number of LPD's would be 13 for C1 and would be 50 for C2, if B of the invention were 7. Again, for *Pirooz* in view of *Davison*, the corresponding number of LPD's would be 50 for C1 and would be 140 for C2, if B were 30. Thus, one skilled in the art would be disinclined to combine the teachings of *Davison* with either *Pirooz* alone, or *Pirooz* in combination with *Verhaverbeke*. To do so would produce the extremely undesirable results discussed above, in which the greatly increased number of LPD's produced is completely undesirable.

Accordingly, claims 12-15 are patentable over *Pirooz et al.* in view of *Verhaverbeke* (U.S. Patent No. 6,132,522) as applied to claims 1-9 and 11, and further in view of *Berman* (U.S. Patent No. 5,014,737), or *Davison et al.* (U.S. Patent No. 5,593,538).

The fee of \$500.00 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) is enclosed. Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978.

Respectfully submitted,

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Enclosure - Appendix

VIII. CLAIMS APPENDIX

The Appealed claims are as follows:

1. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, consisting of the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O₃ solution containing O₃ and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O₃;

whereby these treatment steps form a treatment sequence B₂, which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths.
2. The process as claimed in claim 1, wherein the treatment sequence B₂ is preceded by a treatment B₁ of the semiconductor wafers with an aqueous SC-1 solution.
3. The process as claimed in claim 1, wherein the treatment sequence B₂ is followed by a treatment B₃ comprising drying the semiconductor wafers.

4. The process as claimed in claim 3, wherein the treatment of the semiconductor wafers is sequenced according to the term $m * (B_1 + B_2) + B_3$,

m being an integer number and the treatment B_1 and the treatment sequence B_2 being carried out in succession, and

this taking place m times, before the drying treatment B_3 is performed.

5. The process as claimed claim 1, wherein in treatment sequence B_2 , the aqueous HF solution contains HF in a concentration of from 0.001% to 2% by weight and optionally HCl in a concentration of up to 2% by weight and optionally a surfactant; and

wherein all percents by weight are based upon the total solution weight.

6. The process as claimed in claim 1, wherein in treatment sequence B_2 , the aqueous O_3 solution contains O_3 in a concentration of from 1 ppm to 30 ppm and is optionally exposed to megasonic waves.

7. The process as claimed in claim 1, wherein the treatment liquid used last in the treatment sequence B_2 contains ozone and is optionally exposed to megasonic waves.

8. The process as claimed in claim 3, wherein the drying treatment is carried out using a step selected from the group consisting of centrifuging, using hot water, using isopropanol, and using marangoni principle.

9. The process as claimed in claim 2, wherein in treatment B₁ the aqueous SC-1 solution contains a liquid selected from the group consisting of NH₄OH and H₂O₂, and TMAH (= tetramethylammonium hydroxide) and H₂O₂.

10. (Canceled)

11. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, consisting of the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O₃ solution containing O₃ and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O₃ with exposure to megasonic waves,

whereby these treatment steps form a treatment sequence B₂, which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths.

12. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, comprising the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O_3 solution containing O_3 and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O_3 ;

whereby these treatment steps form a treatment sequence B_2 ; and

circulating the treatment liquids of said baths by taking a part from each of said baths, filtering and returning the part to the corresponding treatment bath.

13. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, comprising the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O_3 solution containing O_3 and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O_3 with exposure to megasonic waves;

whereby these treatment steps form a treatment sequence B_2 ; and

circulating the treatment liquids of said baths by taking a part from each of said baths, filtering and returning the part to the corresponding treatment bath.

14. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, comprising the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O₃ solution containing O₃ and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O₃; and

circulating the treatment liquids of said baths by taking a part from each of said baths, filtering and returning the part to the corresponding treatment bath;

whereby these treatment steps form a treatment sequence B₂, which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths.

15. A process for the wet chemical treatment of semiconductor wafers with treatment liquids in baths, comprising the steps of

firstly treating the semiconductor wafers in a bath with an aqueous HF solution containing HF and optionally HCl and optionally a surfactant;

then treating the semiconductor wafers in a bath with an aqueous O₃ solution containing O₃ and optionally HF; and

then treating the semiconductor wafers in a bath with an aqueous HCl solution containing HCl and optionally O₃ with exposure to megasonic waves; and

circulating the treatment liquids of said baths by taking a part from each of said baths, filtering and returning the part to the corresponding treatment bath;

whereby these treatment steps form a treatment sequence B_2 , which avoids rinsing with water or another treatment liquid and the addition of fresh water or other liquids to the treatment baths.